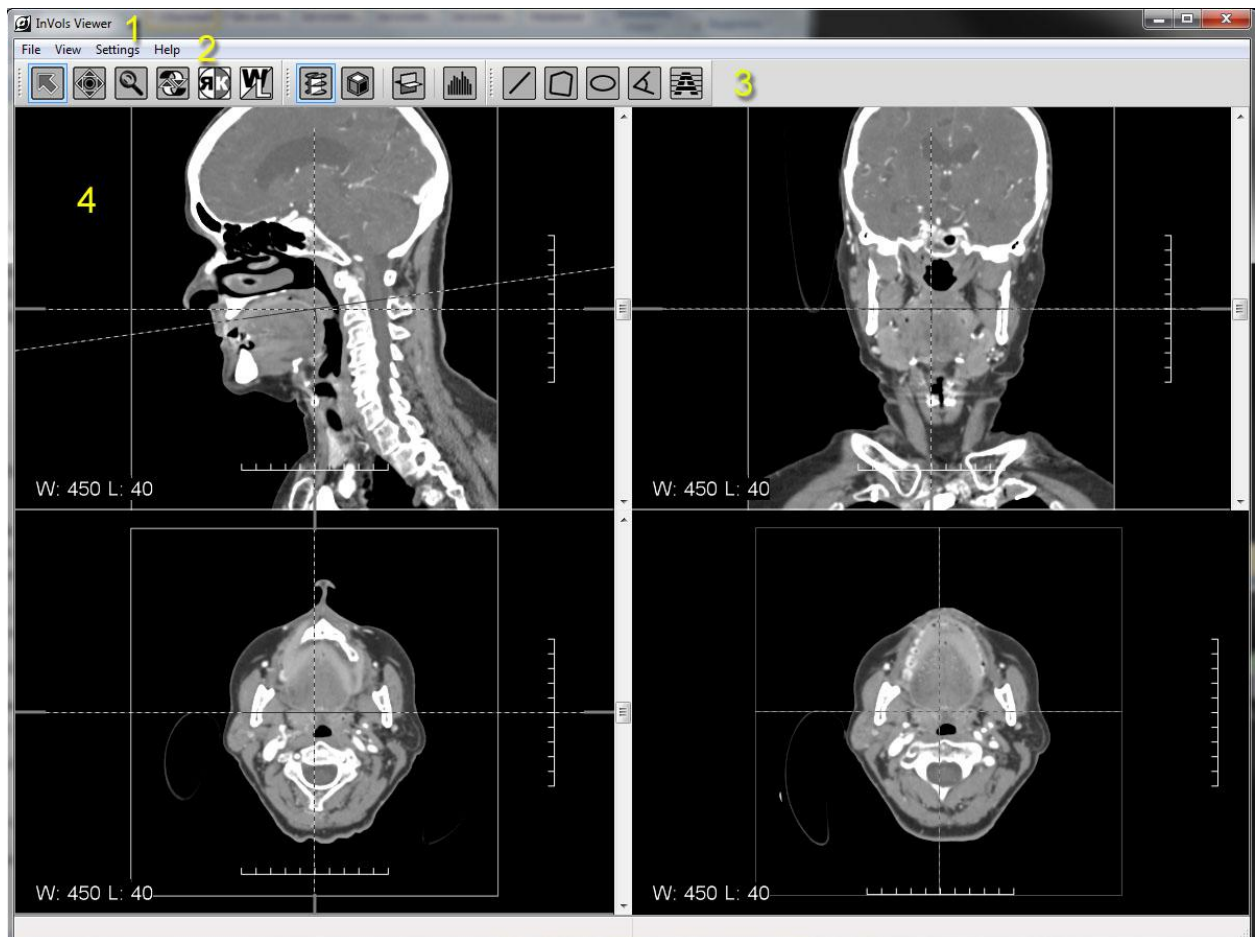


InVols software user manual

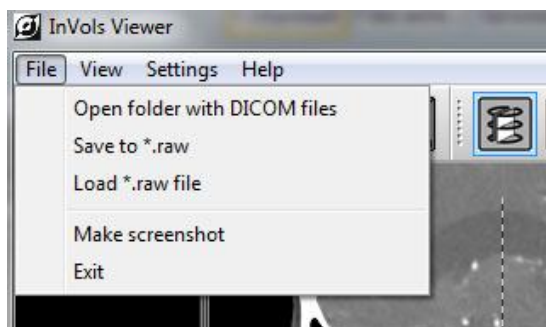
The InVols software application is intended for MPR and 3D visualization of medical datasets in Dicom 3.0 and RAW file formats. When starting the program you will see the MPR browsing mode by default. Graphical user interface is represented by the window header (1), the menu bar below (2), toolbar (3) and the working area (4)



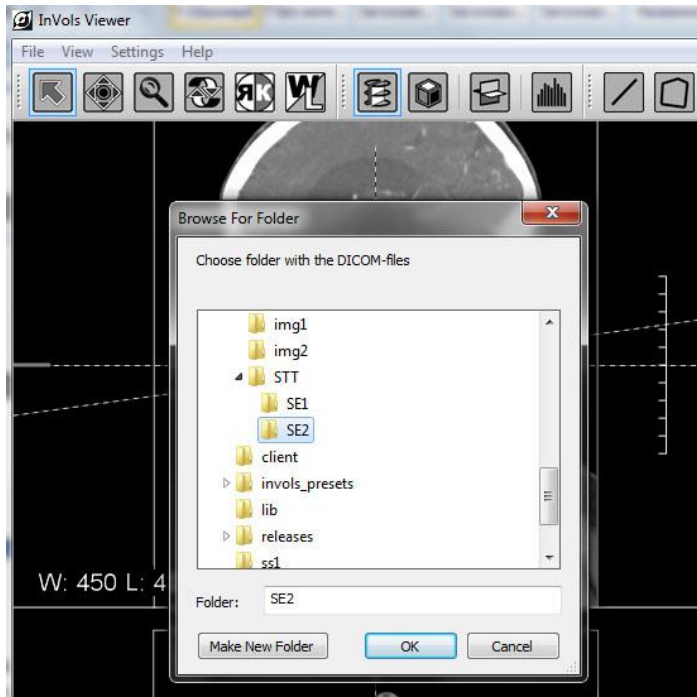
Menu bar items

File

1) Open folder with DICOM files. 2) Save to *.raw. 3) Load *.raw file. 4) Make screenshot. 5) Exit.

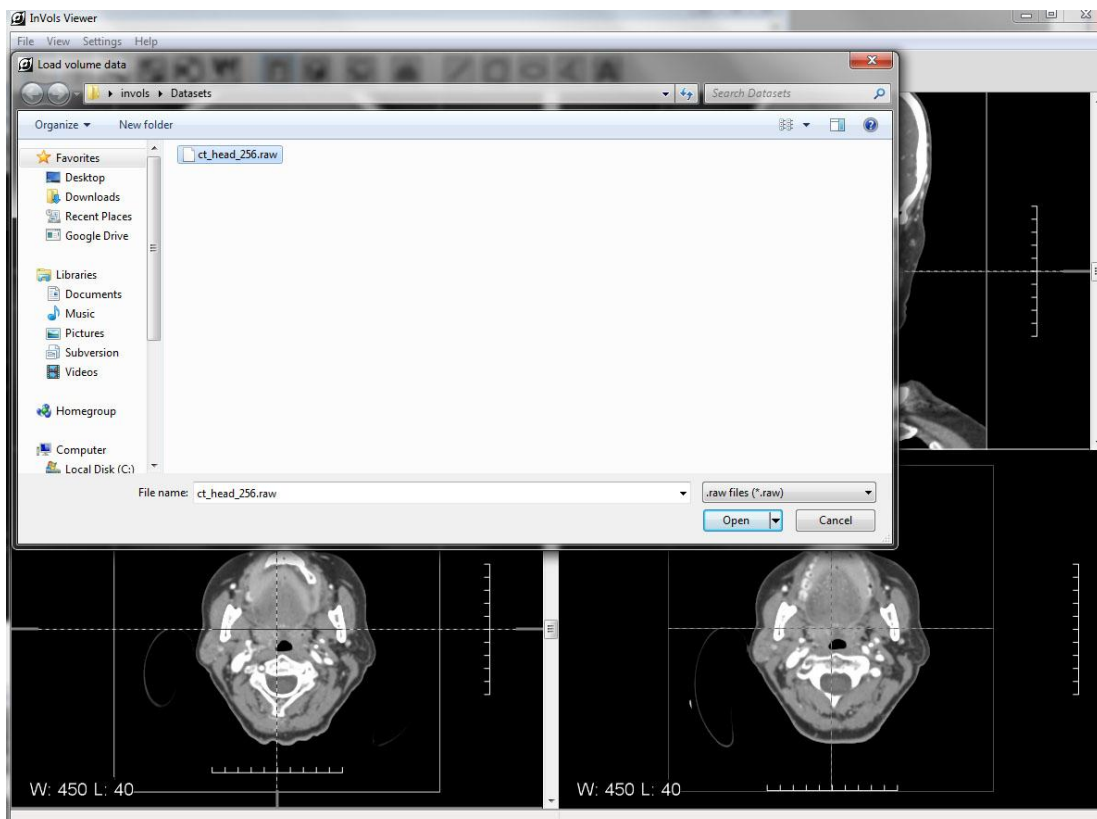


Choose «**Open folder with DICOM files**» to load medical CT or MRI data in DICOM file format. Please note that not all DICOM format issues are supported (like decoding compressed images, for instance).

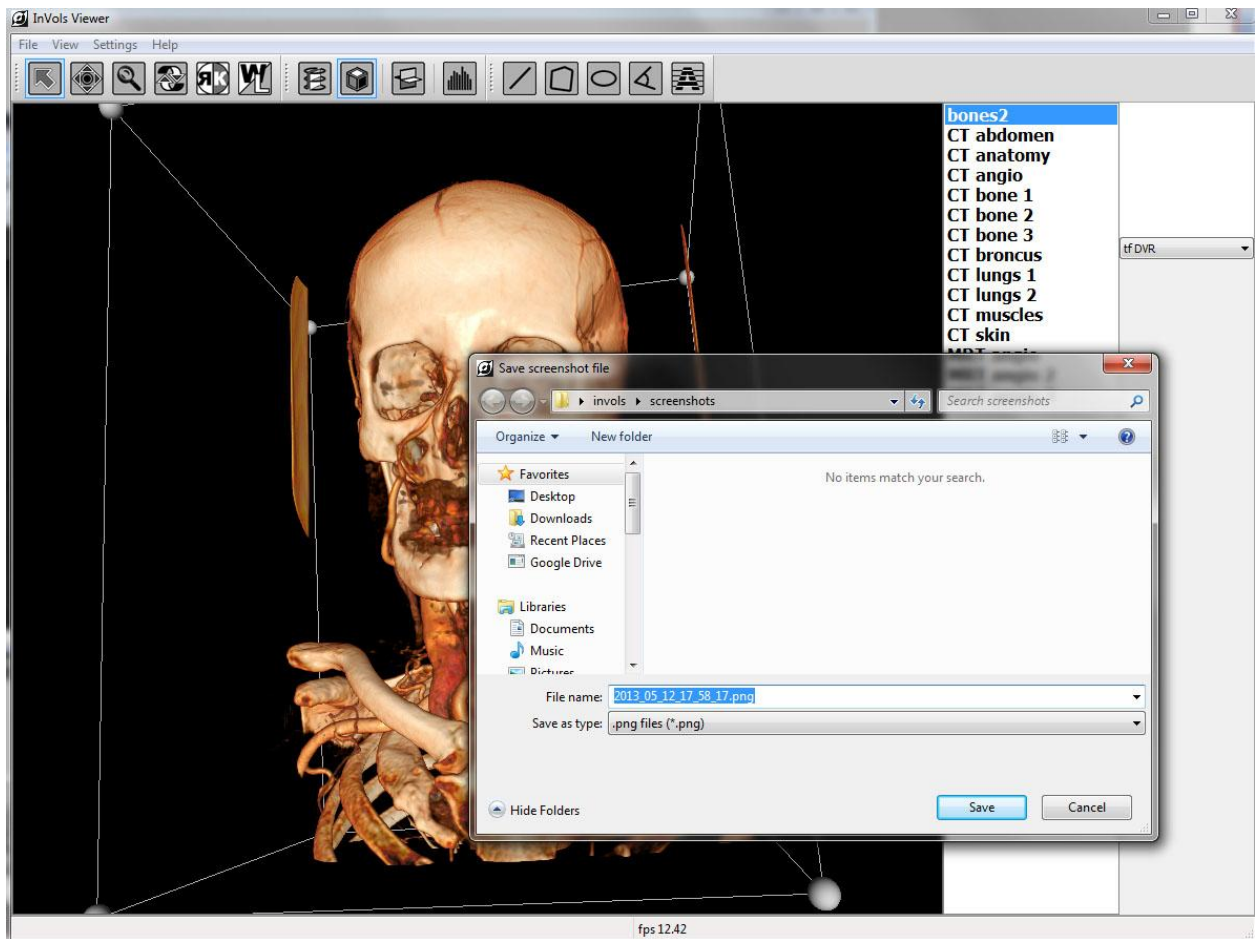


Once you have managed to load a dataset into the system you can always save the dataset in binary format using «**Save to *.raw**».

To load a dataset from the binary file choose «**Load *.raw file**».



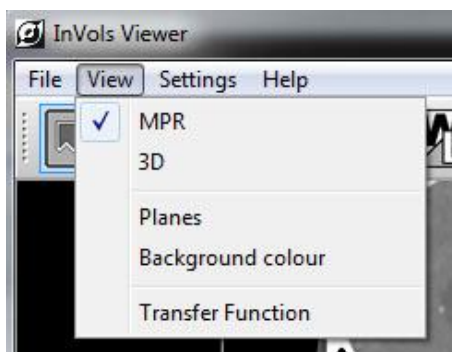
«**Make screenshot**» makes a screenshot of the 3D rendering area (so it does not work in MPR mode) and stores the image in PNG format into the file, specified by the user. Please note that you should switch to 3D mode before making screenshot.



To end working in InVols choose «**Exit**»

View

1) MPR. 2) 3D. 3) Planes. 4) Background colour. 5) Transfer Function.

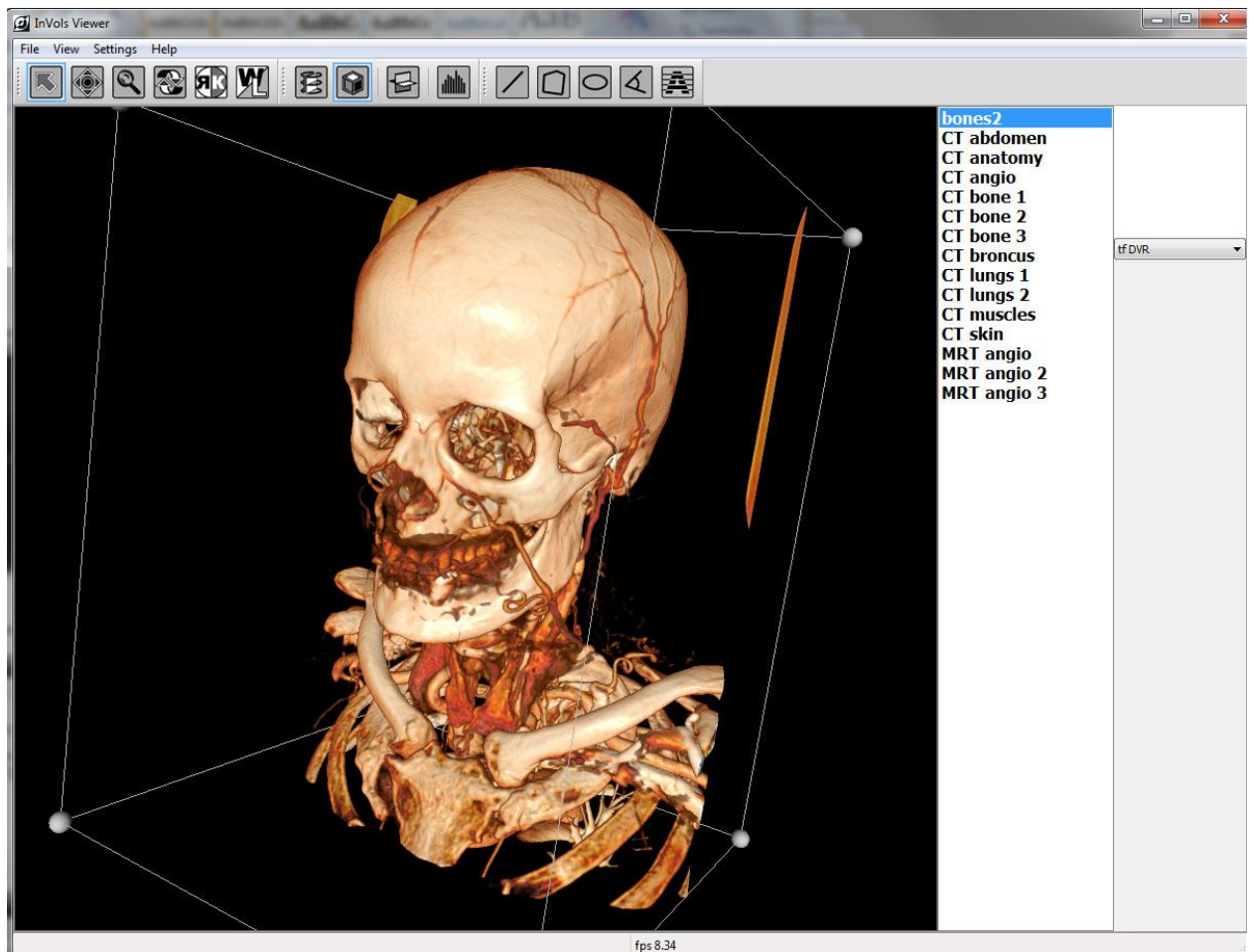


Use «**MPR**» and «**3D**» (or tools ) to switch between MPR and 3D visualization modes that are presented below for the same medical dataset:

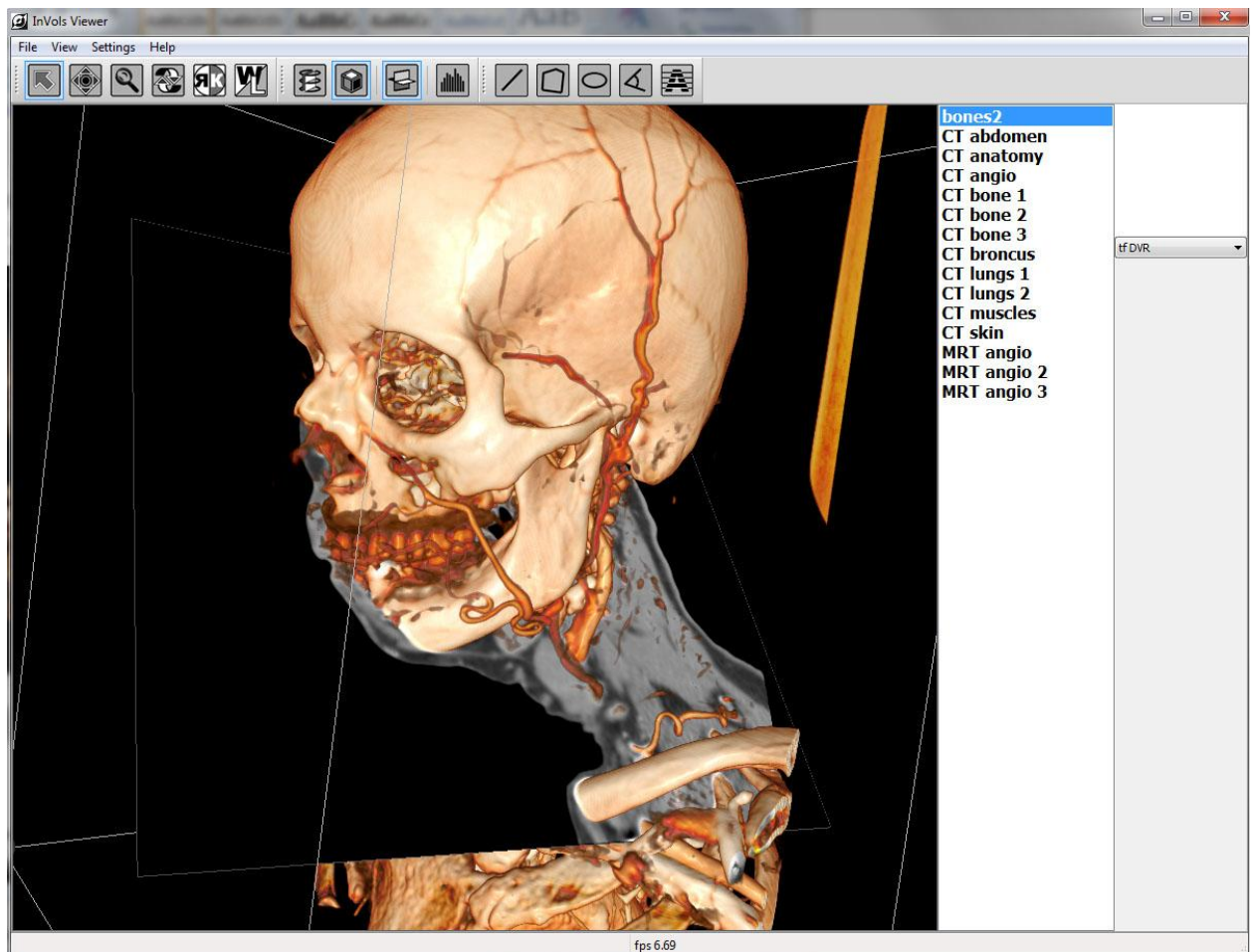
a) *MPR mode:*



b) 3D mode:



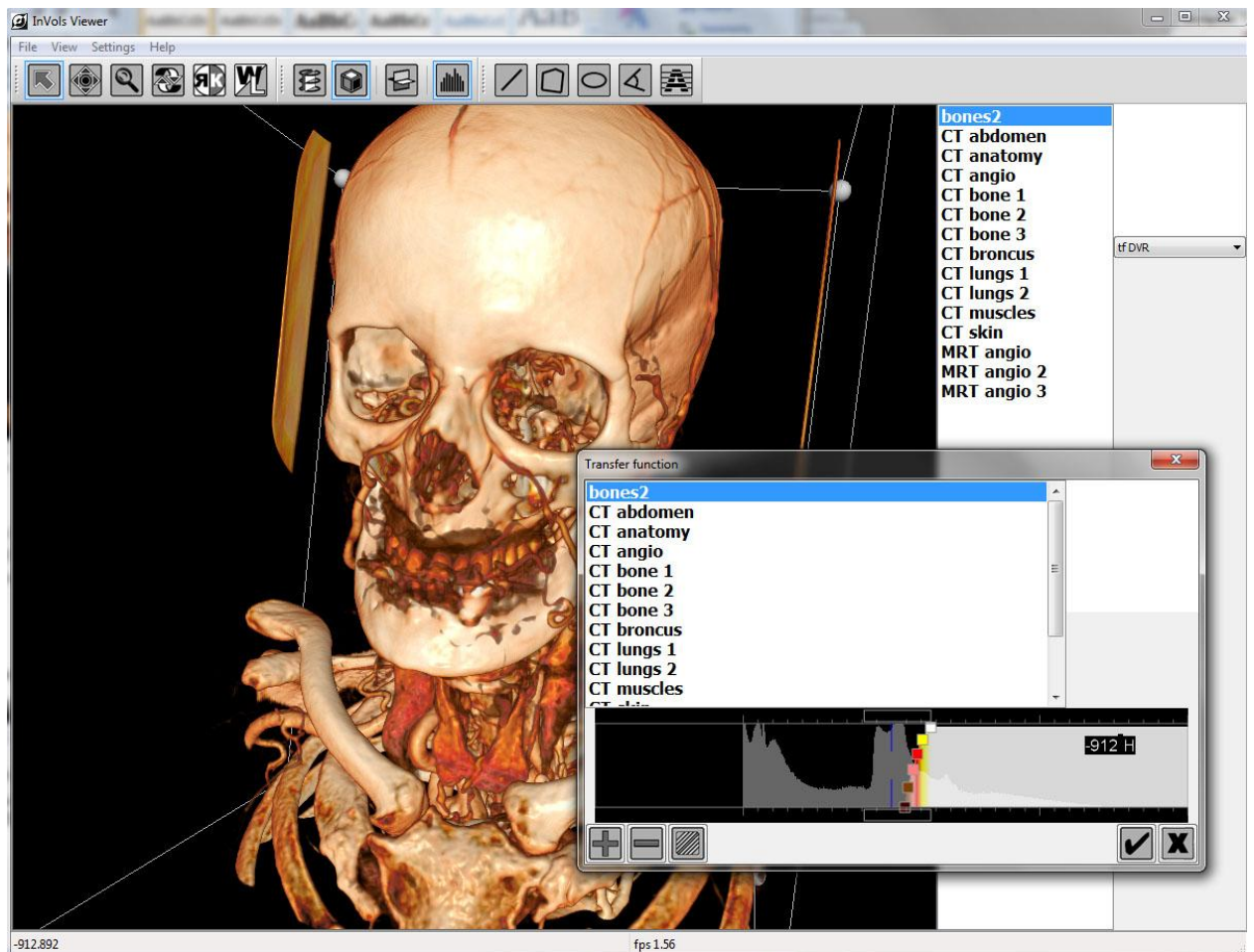
Use «**Planes**» (or tool ) to switch on/off MPR oblique plane visualization in 3D mode:



Use «**Background color**» to change the background color for 3D mode (it is black by default).

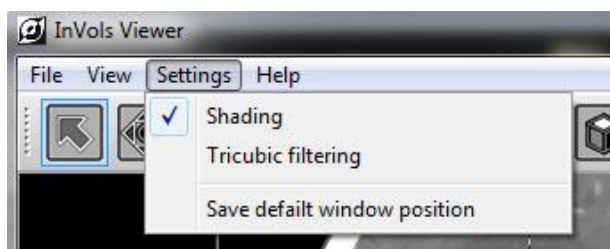


Use «**Transfer Function**» (or tool ) to show/hide the Transfer function window, where a coloring (transfer function) for the volumetric dataset can be chosen from the presets, or you can yourself change and create new transfer functions (see “Transfer Function”).



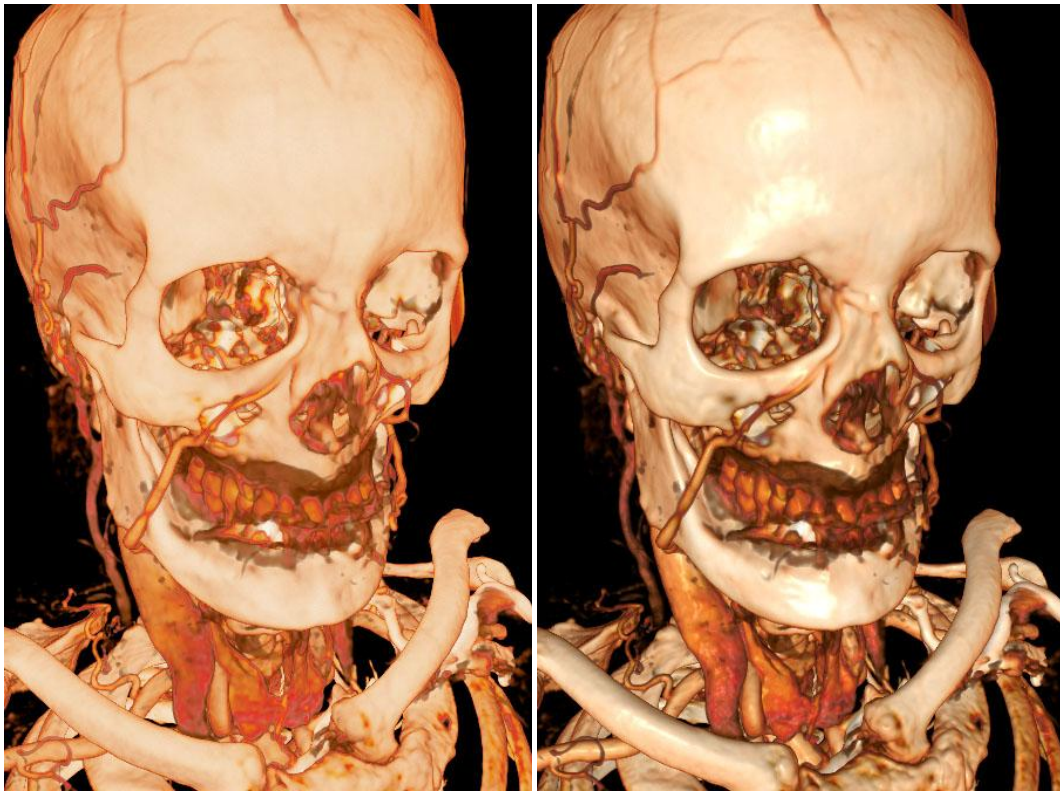
Settings

1) Shading. 2) Tricubic filtering. 3) Save default window position.



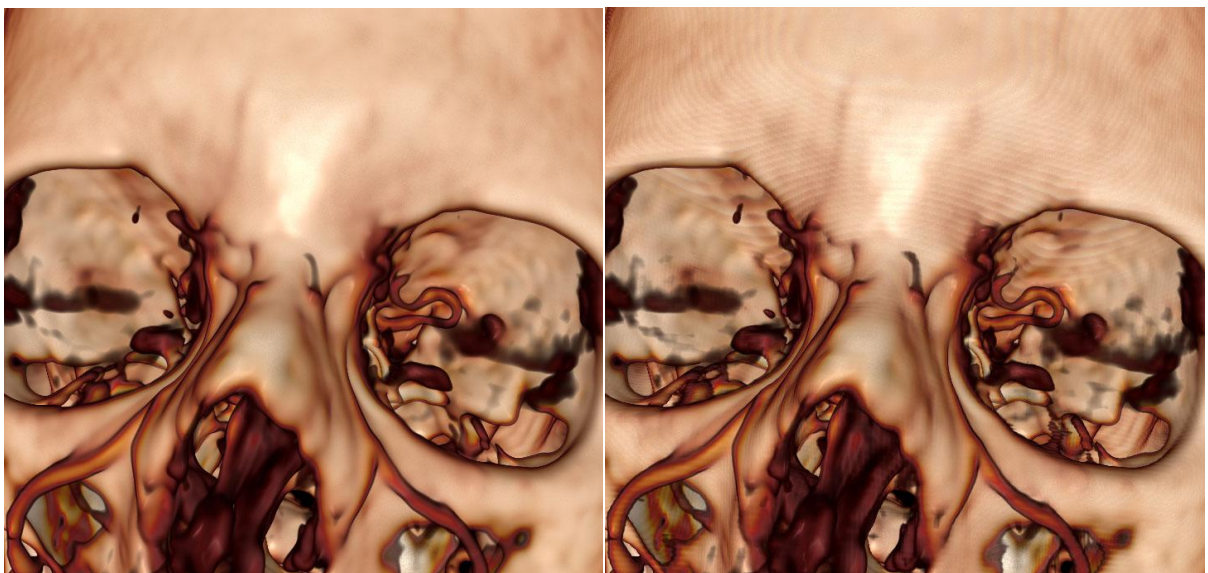
Use «**Shading**» to switch on/off the shading for the 3D mode. Switching this option off should accelerate the rendering performance.

Rendering with (left) and without (right) the shading option:



Use «**Tricubic filtering**» to switch between trilinear (by default) and tricubic data interpolation for the 3D mode. Please note that switching this option ‘on’ will significantly slow down the output. In some occasions, though, it will improve rendering quality.

Rendering with (left) and without (right) the tricubic filtering option:



Use «**Set default window position**» to use the current window position when starting the program next time.

Help

1) Help. 2) About.



«**Help**» – opens this manual.

«**About**» – shows information about the program itself and the author.

Toolbar items

All Tools arranged into 3 groups: 1) «**Control**»; 2) «**View**»; 3) «**Measurements**». Some of the tools double menu bar fun functionality. The tooltip of each tool is defined by its name.

Control



Tool «**Object edition**»



Switches mouse buttons functionality for objects edition (clipping box, MPR planes, and measurement tools)

Tool «**Translate**»



Switches mouse buttons functionality for the camera translation mode.

Tool «**Zoom in/out**»



Switches mouse buttons functionality for zooming in/out.

Tool «**Rotate**»



Switches mouse buttons functionality for the camera rotation mode (in 3D mode only).

Tool «**Window edition**»

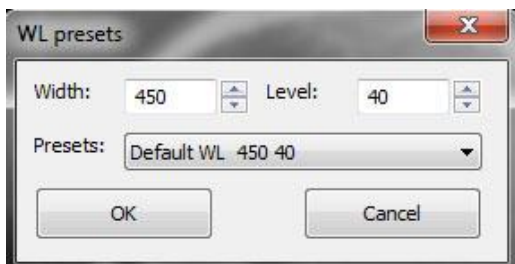


Switches mouse buttons functionality for adjusting window/level values.

Tool «**W/L presets**»



Opens a dialog window (below) to select window/level values pair from the list or define them.

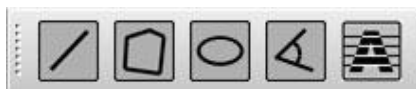


View



Tools «**MPR**», «**3D**», «**Planes**» and «**Transfer function**» have the same functionality, as the corresponding menu bar items.

Measurements



Tool «**Line**»



Measurement of distances in cm.

Setting this tool on changes mouse buttons functionality to begin creation of Line objects. This also counts for any other measurement tool. To stop creation mode press right mouse button. To delete selected object or its point press <DELETE>. Objects can be created only in MPR mode. Use context menu to add new points.

Tool «**Lines loop**»



Measurement of the mean data value inside an area inside a lines loop.

Tool «**Ellipse**»



Measurement of the mean data value inside an area inside an ellipse.

Tool «**Angle**»



Measurement of the angle in degrees between two lines (the first and the last in the line sequence).

Tool «Clear notes»



Remove all measurement tools.

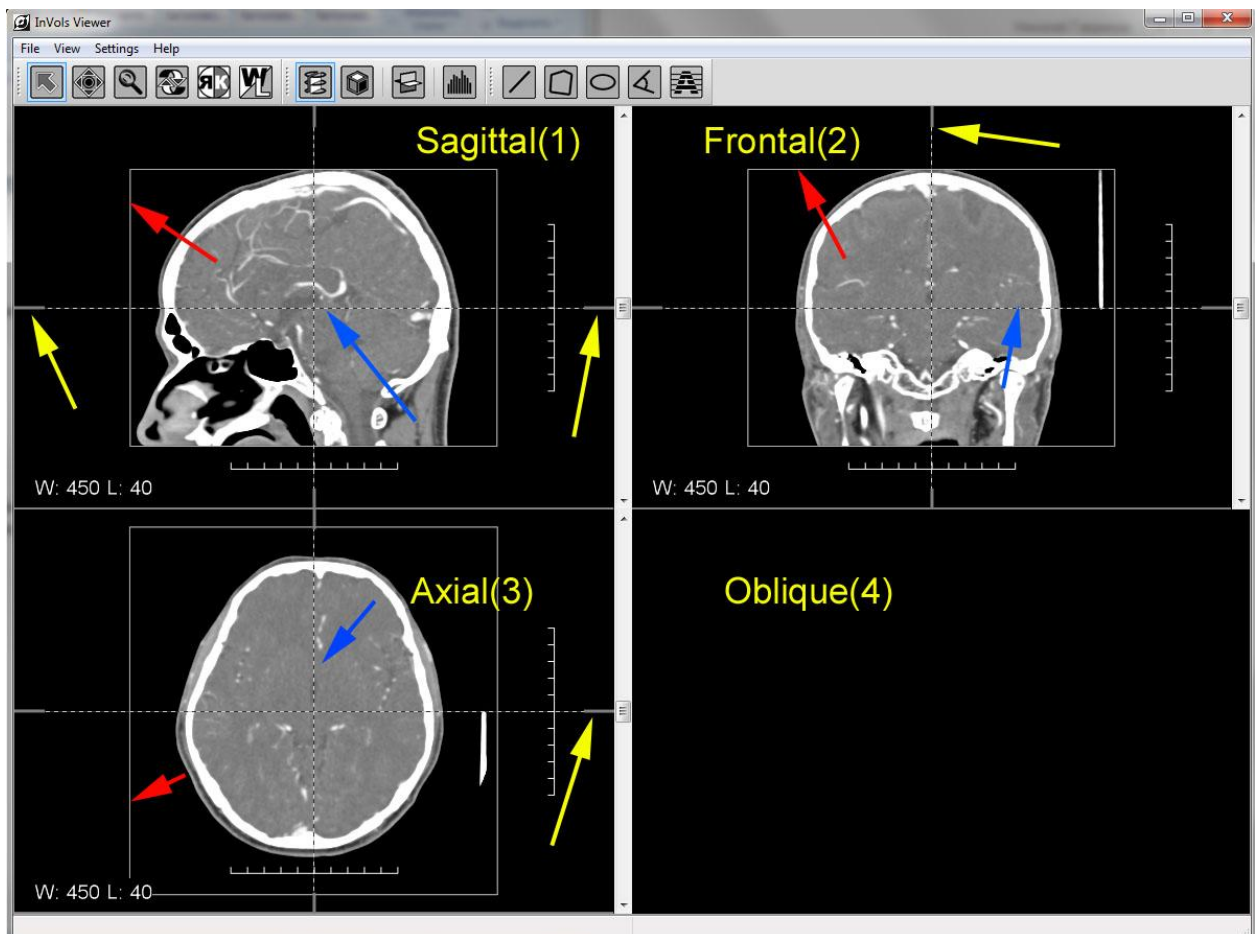
MPR mode

It is a viewing mode by default. In this mode the main window is divided into four windows for browsing MPR sections: sagittal (1), frontal (2), axial (3) and oblique (4). When starting the program the oblique plane is not defined and the corresponding window is empty.

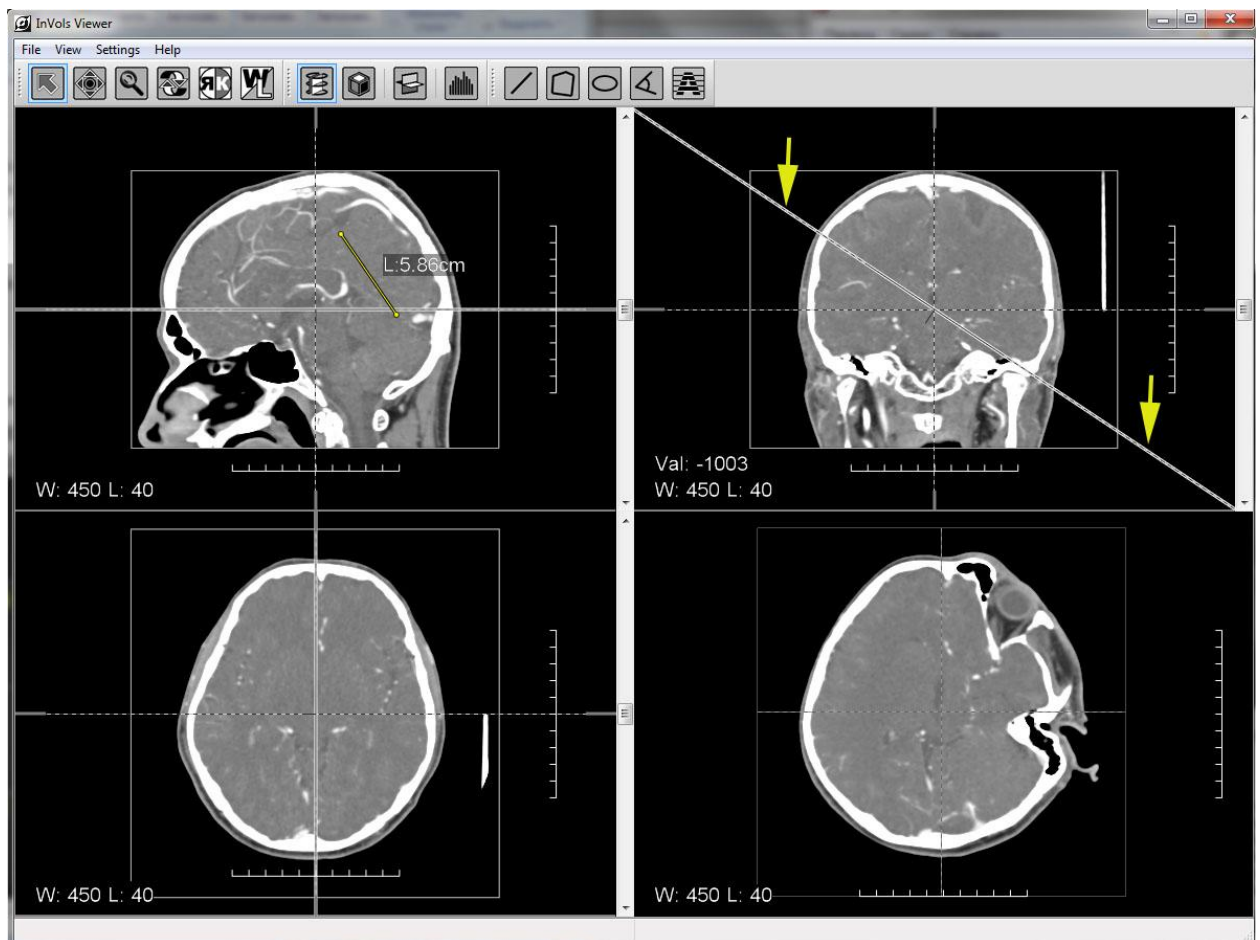
Using selection mode (tool ) you can:

- 1) Drag MPR center on one of the MPR planes (blue arrows).
- 2) Define oblique plane (yellow arrows).
- 3) Change clipping box (red arrows).

MPR center is a point where all four MPR planes are intersecting.



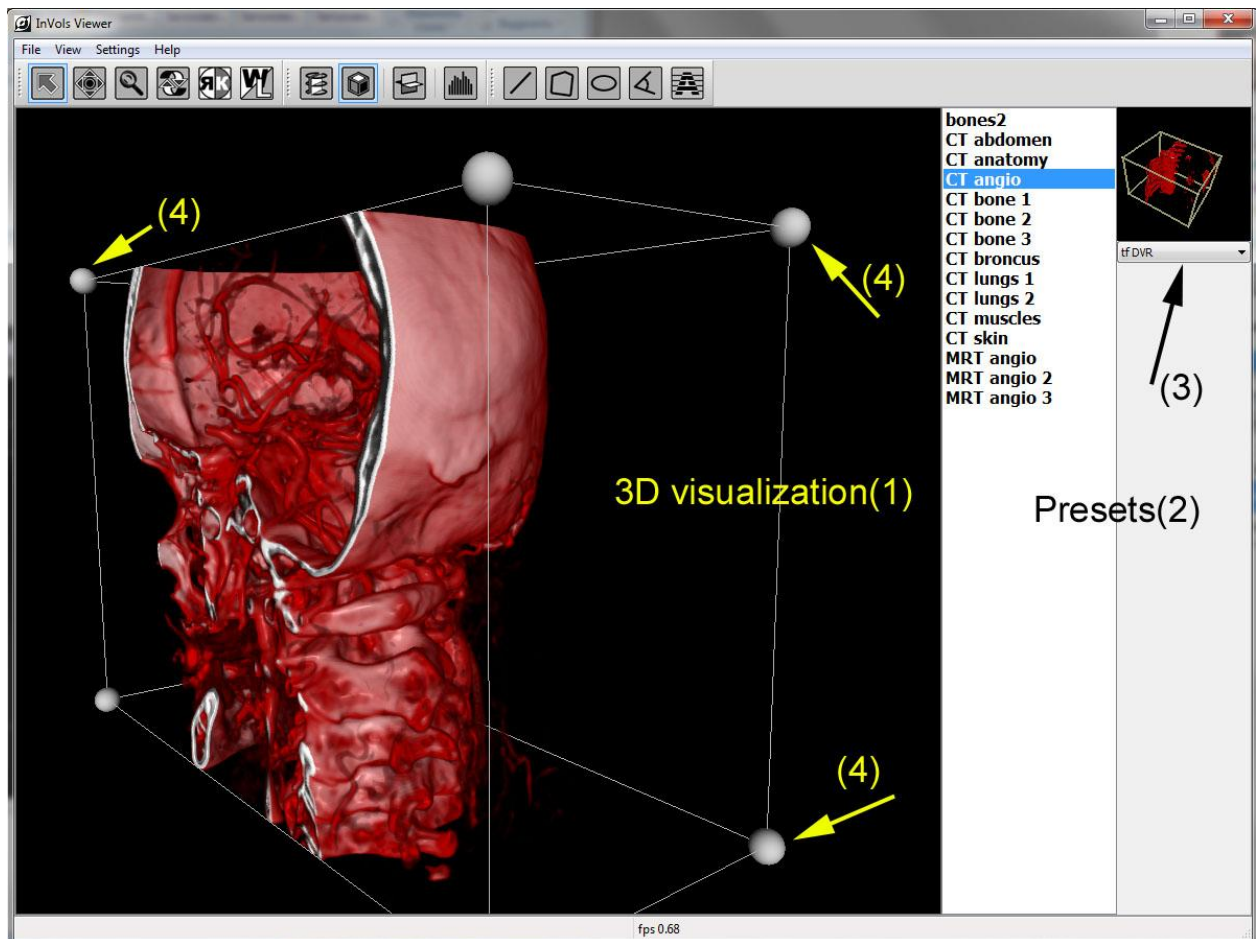
When the oblique MPR plane is defined, user can rotate the plane in windows (1), (2) and (3) (yellow arrows).



3D mode

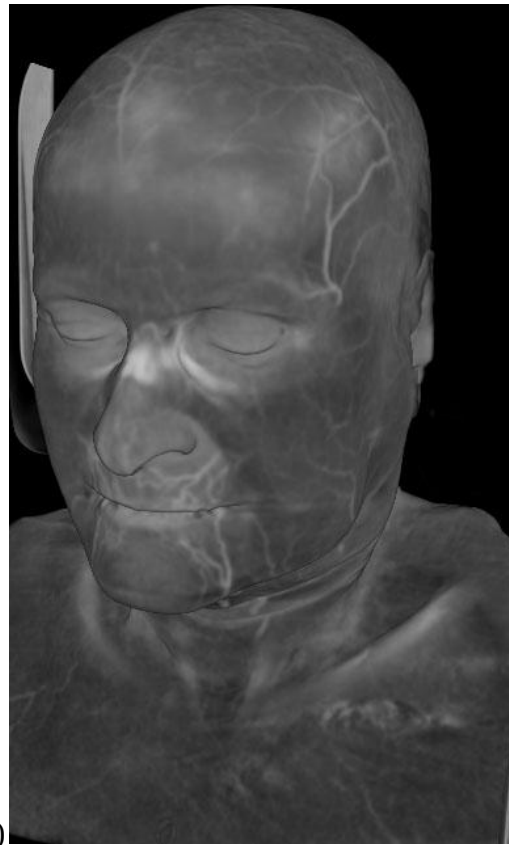
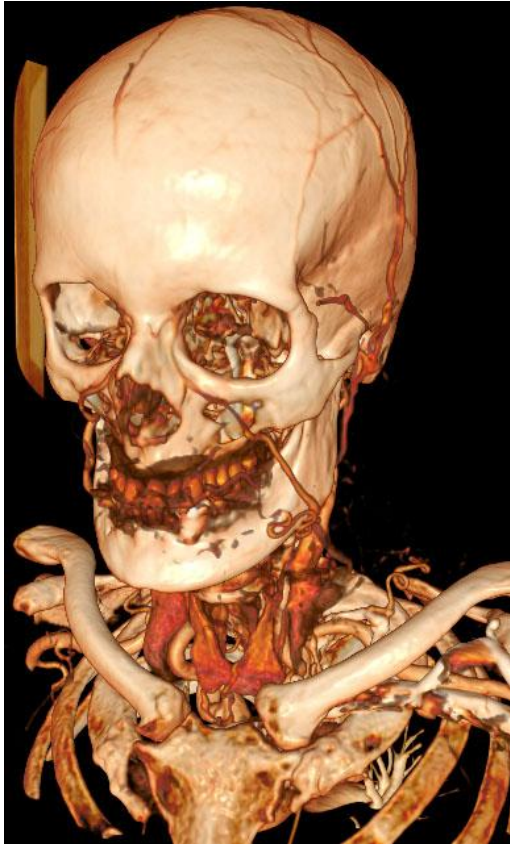
In 3D mode the main window is divided into the 3D visualization window (1) and presets window (2).

- 1) Rendering is performed in 3D visualization window, you can adjust control points of the clipping box (4) using mouse and selection mode (tool ).
- 2) You can select a transfer function from the list. Double click on any preset will open the Transfer Function window.



You can choose visualization algorithm from list (3):

- 1) tf DVR – Direct Volume Rendering with colored transfer function.
- 2) wlDVR – Direct Volume Rendering with gray-scaled transfer function, defined by W/L values.
- 3) SSD – Shaded Surface Display. The iso-value is defined by Level value of W/L.
- 4) MIP – Maximal Intensity Projection (is defined by current W/L).
- 5) MinIP – Minimal Intensity Projection(is defined by current W/L).



RAW file format

A dataset in RAW file format are stored into *.raw file slice by slice, while additional information is stored in corresponding *.raw.txt file. For example, *File_name.raw* is a binary file, that contains the dataset as a 3-dimensional matrix. (considering V_{ijk} to be the value of cell of index $[i,j,k]$, the file will contain the following values: V_{000} , V_{100} , V_{200} , ..., $V_{n-1\ 00}$, V_{010} , V_{110} , V_{210} , ..., $V_{n-1\ m-1\ 0}$, V_{001} , ..., $V_{n-1\ m-1\ p-1}$). *File_name.raw.txt* contains the information below:

name	type	Description	Value by default
size	ivec3 (3 integer values)	Dataset sizes	-
spacing	vec4 (3 floating point)	Voxel size (mm)	1,1,1
format	enum (SHORT, USHORT or UBYTE)	Data values format	SHORT
data_values_offset	Integer	Data values offset	0
data_values_scale	Integer	Data values scaling	1
window_level	Integer	Window Level (HU)	0
window_width	Integer	Window Width (HU)	0
modality	string	Data modality	null

Here is an example of txt file from the Datasets folder:

```
size: 256 256 277
spacing: 0.86 0.86 0.60
format: SHORT
data_values_offset: 0
data_values_scale: 1
window_level: 40
window_width: 450
modality: CT
```

To obtain data values in Hounsfield units one should do the following operation with all dataset cvalues:

Output units = $m \cdot SV + b$.

Where

Output units – the resulting value in HU;

m corresponds to the Rescale Slope (0028,1053) parameter in DICOM file

b – Rescale Intercept (0028,1052)

SV – source value from the file.

Transfer Function

«Transfer Function» window allows for choosing a predefined transfer function (TF) from the presets list (1) and for creation of new user-defined transfer functions. To show/hide this window use  tool.

On the histogram area (2) you may adjust current transfer function to change the appearance of the dataset in 3D mode (please note that changes would be seen only when using «tf DVR» rendering algorithm which is used by default). To add or remove control points of the current TF use buttons below on the left (3). You can also use the right mouse button to create/delete control points. To select and drag points use left mouse button. Mouse wheel can be used to scale histogram area (by scrolling) and to translate it (press & drag).



To save changes press  button (4) – a new TF will be created. Please note that the current rendering image of 3D mode will be saved as well and used as a preview image on the right (5).

To remove a TF from the list (1) you may use  button (4).